Technology Opportunity

Two-Dimensional Analysis and Design Codes for Turbomachinery

The National Aeronautics and Space Administration (NASA) seeks to transfer NASA-developed two-dimensional (2-D) methods for analyzing and designing turbomachinery blading.

Potential Commercial Uses

- Conceptual design of compressors
- Design of axial or centrifugal compressors
- Detailed performance maps for operation
- Development of commercial pump and compressor designs
- Aircraft propulsion
- Auxiliary power
- Automotive engines
- Turbochargers

Benefits

- Higher efficiencies
- Faster design cycle times
- Lower direct operating costs
- Improved reliability

The Technology

Two-dimensional methods for analyzing and designing turbomachinery blading have been developed to determine the spanwise distributions of aerothermodynamic parameters. The codes typically can be used to determine stage loading, blade row turning, and efficiency potential. They can also be used to estimate the performance, pressure loads, and preliminary flow path and blading. The codes
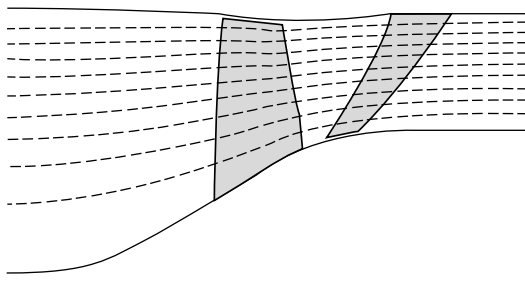
Two-dimensional flow computation.
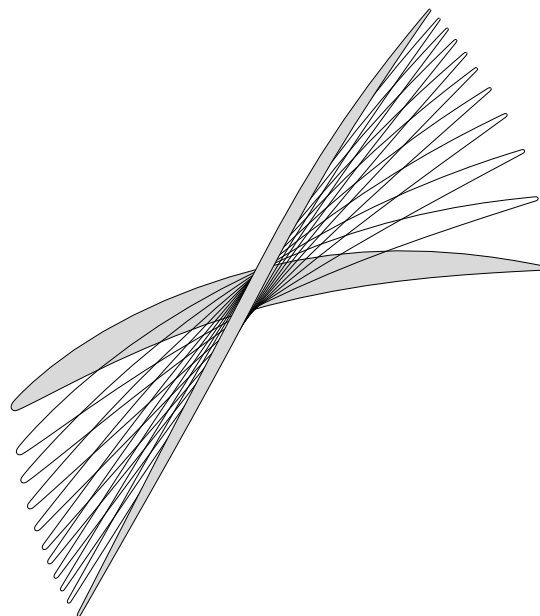
Blade sections for fan rotor.

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were developed as a design/analysis method capable of determining the performance of a compressor with a higher degree of fidelity.

Over a 30-year time period NASA Lewis Research Center has conducted substantial compressor aerodynamic research, which served as a basis for the development of 2-D codes. These codes are robust, fairly fast computationally, and reasonably accurate. They require minimal input and are best used to analyze and compute the more detailed characteristics of compressor aerodynamics.

Options for Commercialization

NASA Lewis Research Center has no patents on the codes and release is subject to export law controls. Any company may acquire the codes and improve on the capability to create a preliminary compressor design. The codes may be used to develop and enhance design tools for commercial applications.

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Key Words

Compressor performance
Compressor 2-D analysis/design tools
Computational fluid dynamics
Grid generation

Compressor Research and Development 2-D Codes

(a) Description of NASA compressor aerothermodynamic prediction codes

Code	Brief Code Description
CDP	Compressor design program; axial fan/compressors; geometry generation
COD	Compressor off-design program
CCGEOM	Geometry generation code
TIGGERC	2-D interactive generic grid generator; operates on SGI platforms
MTSB	Meridl, Tsonic Blayer coupled analysis package for turbomachinery
DVC2D	Advanced 2-D axisymmetric viscous duct solver
RVCQ3D	Quasi-3-D blade-to-blade viscous turbomachinery flow solver
PCPANEL	Airfoil panel method solver

(b) Aerothermodynamic code requirements and uses in various compressor design stages

Preliminary design stage	Code characteristics	Typical trade studies	Aerothermodynamic uses
•CDP •COD •PCPANEL •CCGEOM •MTSB/CCGEOM •RVCQ3D •TIGGERC (2D) •DVC2D	Robust; User friendly; Fast computationally; Good accuracy	Spanwise distribution of aerothermodynamic parameters; Flow path definition; Grid generation; Detailed blading	Performance prediction; Pressure loads; Conception of flow path and blading

(c) Experience and time requirements for NASA compressor aerothmodynamic prediction codes

Code	Typical user experience	Typical time required to learn code	Set-up time	Typical times for an average case	Computer required	Where to obtain the code
CDP	Moderate	~2 wk	< 2 days	~seconds	PC	COSMIC/Lewis
COD	Moderate	~2 wk	< 2 days	~seconds	PC	COSMIC/Lewis
CCODP	Low	~1 wk	~minutes	~seconds	PC	Lewis
CCGEOM	Low	~1 wk	~minutes	~seconds	PC	Lewis
TIGGERC	Moderate	~2 wk	<1 day	~seconds	Mini	COSMIC/Lewis
MTSB	Moderate	~2 wk	<1 wk	~seconds	PC/mini	COSMIC/Lewis
DVC2D	Moderate	~2 - 3 wk	<1 wk	~minutes	PC/mini	Lewis
PCPANEL	Low	~1 wk	~minutes	~seconds	PC/mini	Lewis

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